Editorial for June 2020 Issue

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It is my privilege to write this editorial along with three of my Distinguished friends and academic colleagues for decades. They are Professor Navakanta Bhat, Chairman, Center for Nano Science and Engineering, Indian Institute of Science, Bangalore, Professor Krishna Sivalingam, Former Head of the Department of Computer Science and Engineering, Indian Institute of Technology Madras, and Professor Sanjiva Prasad, Chairman, Department of Computer Science and Engineering, Indian Institute of

Technology, Delhi. We constitute the National Academic Advisory Committee for the largest program of Government of India focused on Electronic Systems Design and Manufacturing, Information Technology, and Information Technology enabled services. The program itself is titled after Sir Visvesvaraya, about whom I had the opportunity to write in one of our earlier issues. The program has two major components; one supporting research students through PhD Fellowships and the other recognizing the Young Faculty in various institutions in India as Research Fellows. The current issue in your hands gives a flavor of the research pursuits by a section of our YFRF awardees. I am sure the reader will find the current issue rewarding and informative.

Navakanta Bhat

The research reported here are from three major areas; they are Electronics System Design and Manufacturing, Information Technology, and Information Technology enabled services. Of these the research related to Electronic System Design and Manufacturing concentrates on Materials and

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Material Science bordering on Nano has six papers; two works based on simulation and three based on experiments.

The paper titled “GaN and Ga₂O₃ based wide bandgap semiconductor devices for emerging nanoelectronics” authored by T R Lenka explores the quantum transport in AlN/ β -Ga₂O₃ based high electron mobility transistor (HEMT) along with the compact model development of GaN-based metal oxide semiconductor (MOS)-HEMT for high frequency and high power electronics resulting in the development of In GaN based nanowire for solar photovoltaics and opto-nanoelectronics applications.

The paper titled “Numerical analysis of high-efficiency lead-free perovskite solar cell with NiO as hole transport material and PCBM as electron transport material” by T R Lenka, A C Soibam, K Dey, T Maung, F Lin, proposes a lead free perovskite solar cell structure with NiO as the hole transport material (HTM), CH₃NH₃SnI₃ as the perovskite absorber material and PCBM (phenyl C₆₁ butyric acid methyl ester) as the electron transport material (ETM). Based on the numerical analysis using Solar Cell Capacitance Simulator (SCAPS-1D) program, they show that the power conversion efficiency (PCE) of the optimized device stack is found to be above 29% with $V_{oc} = 0.98$ V, $J_{sc} = 34.86$ mA/cm², FF = 85.64%. the work opens new vistas in the design and development of such lead-free perovskite solar cell with different HTM and ETM for high PCE.

The paper titled “A review on the sensing performance for three different ternary hybrid (Pd/RGO/TiO₂-NTs, Pd/RGO/MnO₂-NFs and Pd/RGO/WO₃-NFs) gas sensor device structures” by Sunghamitra Ghosal, Partha Bhattacharyya, reports on the experimental comparative analysis of the sensing performance between three fabricated metal oxide based ternary hybrid device structures [Pd/RGO/TiO₂-nanotubes (NTs), Pd/RGO/MnO₂ nanoflowers (NFs) and Pd/RGO/WO₃-nanoflowers (NFs)]. The three dominant aspects; viz., the role of basic sensing matrix where due to extremely high surface to volume ratio of the corresponding nanostructure, high mobility (~ 1600 cm²/V-s) distributed connector among the neighboring nanostructure, and the catalytic activity which reduces activation energy requirement are explored experimentally.

The paper titled “On-chip Dynamic and Static Monitors for Low Power Applications” by Bishnu Prasad Das, focuses on the static monitor using a reconfigurable ring oscillator which extracts the threshold voltage information and a dynamic monitor using warning flip-flop that can be used for dynamic voltage and frequency scaling to achieve low power consumption. Both are experimentally validated in a test chip, that is implemented in CMOS 130 nm technology node.

The paper titled, “Development of Low Noise FET Biosensor using Graphene and ZnO Nanostructures on

Cost Effective Substrates for Biomolecule Detection with Enhanced Performance” by Chirasree Roy Chaudhuri and Bhaswathi Chakraborty follows the current trend to develop nanostructure based biosensing platforms as commercial diagnostic tools for early stage non-invasive virus detection to enhance the selectivity from the existing electrical biosensors by introducing additional electrical signatures and by correlating the electrical characterization data with other proteomics characterization results. Their work focuses on the performance enhancement of available Nano biosensors in terms of sensitivity and selectivity for the early and rapid diagnosis and prognosis of viral infections.

The paper titled “Radio Frequency Bio-Sensing and All Optical Devices”, by Azeemuddin Syed discusses detecting presence of proteins in a given sample is an essential part of diagnostics. To this end, the author proposes the design and modelling of various all-optical devices such as Gyroscope and Modulators in order to arrive at devices with binary output for exploiting the Permittivity of Biotin-Streptavidin combination that exhibits a frequency dependency in several dispersion regions.

The research related to Information Technology has six papers focusing on different aspects of Wireless Communications.

Krishna Sivalingam

The paper titled, “Wireline communication: the backbone of data transfer” by Saurabh Saxena reviews the need for a high-performance wireline communication in the context of wirelessly connected billions of sensor nodes. It compares the performance of the state-of-the-art wireline transceivers and underlines the challenges in improving the performance in the midst of tapering in CMOS technology scaling. This paper elaborates on the ongoing research to track the increasing bandwidth requirements in processing platforms with an affordable power budget. Energy efficient design techniques for clock recovery in multilane receivers, receiver frontend in digital CDRs, reconfigurable

voltage-mode transmitter, and PAM4 equalizer in full-duplex transceivers form part of the discussions.

The paper titled, “Intelligent and secure transceiver design and implementation for future wireless communication” by Sudhan Majhi proposes an intelligent and secure transceiver design and implemented over RF testbed for future wireless communication covering MIMO-NOMA over double cell and multiple scenarios. The authors propose a sequence design to improve peak to average power ratio for OFDM and multicarrier code division multiplexing (MC-CDMA). They argue that these sequences can also remove multiuser interference for CDMA system over asynchronous system by improving the correlation properties within a code.

The paper titled, “Development of spectral-and-energy-efficient wireless communication techniques” by Prabhat Kumar Upadhyay seeks to address the system performance, planning, and resource allocation problems by exploiting cooperation among available network re-sources with renewable energy sources for green wireless communication infrastructure deployment.

The paper titled, “Study on four disruptive technologies for 5G and beyond wires communication” by Vimal Bhatia explores four key technologies, namely cognitive radio, non-orthogonal multiple access in heterogeneous networks, wireless caching, and massive MIMO for 5G and beyond systems. The key ideas are expounded using simulation results that corroborate the superiority of proposed techniques for next generation wireless communication systems.

The paper titled, “Design and Analysis of Spectral and energy efficient wireless communication networks” by Manav Bhatnagar explores the spectral and energy efficiency aspects of future generation networks such as smart grid communications with a view to improving the performance of current and future generation of communication systems.

The paper titled “PUF: A New Era in IoT Security”, by Bibhash Sen proposes an enhanced Configurable Ring Oscillator (CRO) framework which uses latch instead of inverter to build an RO. The proposed design efficiently utilizes the resources found in a configurable logic block (CLB) to increase the number of RO configurations while using the same area. Also, it provides the flexibility to include a latch in an RO configuration which in turns improve the reliability and the security as well. The authors report on experimental results on Xilinx Spartan 3E FPGA to establish that the proposed design exhibits high stability despite varying environmental conditions without using any error correcting code or post-processing technique.

Sanjiva Prasad

The research reported on Information Technology Enabled Services spans twelve papers where logical reasoning, algorithmic thinking, and application potential are showcased. The paper titled, “Aspect-based sentiment analysis search engine for social media data” by Mary Sowjanya Alamanda deals with the extraction of positive or negative opinions from any online content through sentiment analysis using natural language processing. The work proposes an aspect-based sentiment analysis model that uses polarity classification and sentiment extraction on reviews and extracts the most interesting polarity aspects automatically using both machine learning and deep learning algorithms.

The paper titled, “Improved methods for software fault prediction and web service selection” by Sandeep Kumar deals with the creation and maintenance of actual software using empirical software engineering and web service selection. The authors focus on issues such as improved Software Fault Prediction that deals with the identification of faults in the software modules using statistical or machine learning methods and Software Effort Estimation that focuses on the quantification of the efforts required for the development of any software.

The paper titled, “Enhancement of electricity wheeling charges by incorporating FACTS controller in restructured power systems” by Anoop Arya, Gaurav Gupta, Manisha Dubey describes the FACTS incorporated power flow model for the determination of flow of real and reactive power by using the power flow tracing principle, which involves matrix properties for the real and reactive power allocation and cost allocation for different participants. They share comparative results with and without FACT controller for the sample 5 bus systems, including the IEEE 14 bus system.

The paper titled, “Achieving sustainability through smart city applications: protocols, systems and solutions using IoT and wireless sensor network” by Maneesha Vinodhini Ramesh, Rekha Prabha, Hemalatha Thirugnanam describes four major research directions in smart city application areas such as (a) design and deployment of

an IoT system for early warning of landslides, (b) heterogeneous wireless communication design and optimization for enabling real-time management of interoperation of heterogeneous devices and data services in a hybrid electrical network, (c) development of (low-cost) IoT sensors for remote patient monitoring and (d) design and deployment of systems and solution for providing mobile offshore connectivity for fishing vessels - internet over sea.

The paper titled, “Smart residential electricity distribution system (SERDS) for demand response under smart grid environment” by Selvan Manickavasagam Parvathy shares the experience in the development of a Smart Residential Electricity Distribution System (SREDS) for enabling Smart Residences (SR) to participate in Demand Response (DR) schemes of Power Distribution Company (PDC) with either Flat Rate tariff, Time of Use tariff or Real Time Pricing. SREDS includes a Smart Energy Meter (SEM) enabled with Internet of Things, an Intelligent Residential Load Management System (IRLMS) with Wi-Fi connectivity, distributed Wi-Fi enabled Smart Load Nodes (SLN) and Smart Battery Charing/Discharging Controller (SBCDC).

The paper titled, “Optimal generator side bidding with carbon emission trading and risk management” by Anoop Arya, Somendra P S Mathur, Manish Dubey presents an optimal bidding strategy for a supplier, considering rival’s bidding behavior, in an hourly day-ahead pool market. The bidding problem has been formulated as a Bi-Level Multi Objective Optimization Problem (BLMOOP), where in the first level generator submit bid strategically to the ISO and in the next level a particle swarm optimization (PSO) approach has been employed for the maximization of social welfare with risk management. The practicability of proposed optimization method is examined by an IEEE-30 bus system which consists of six suppliers.

The paper titled, “Face Recognition under unconstrained environment for videos from internet” by Poonam Sharma presents a modified algorithm using curvelet and DCNN in order to overcome the limitation of unconstrained environment in face recognition.

The paper titled, “Towards building an Affect-aware Dialogue Agent with Deep Neural Networks” by Asif Ekbal describes research related to introducing

courteousness in a dialogue agent, and natural language generation (NLG) in a multi-modal setup involving text and images.

The paper titled, “Real time embedded system development for missile angular position acquisition through image processing” by Moorthi S and Sairam D suggests a system to communicate from a Missile Launch vehicle to the control center. An algorithm to calculate in real time the angular position of the missile using the video streams captured from three different cameras are used as the basis.

The paper titled, “Deep Neural Network Based Approach for Processing Sequential Data” by Lavanya Devi Golagani, Naresh Nelaturi, and Srinivasa Rao Kurapati reports on their work focused on processing sequential data in the domains of ambient air quality management and recommender systems. Their research aims to build a model to predict ambient air quality using Amplified Recurrent Neural Networks for a particular geographical area and develop deep learning-based recommenders/personal assistance/advisory systems to support user’s preferences.

The paper titled, “Research Work Under YFRF” by Rajib Kumar Jha and Sumit Kumar concentrates on developing new methodologies for weak signal detection in the watermark detection application. The authors investigate a new detector based on the fractional operator. The proposed detector has been used to detect the DC signal present in Gaussian noise. The performance is compared with state-of-the-art detectors such as a threshold detector (TD), neural network-based detector, etc. The robustness of the proposed detector with respect to the parameters of signal and noise has also been explored.

The paper titled, “Face Image Retrieval via Sum and Difference Histograms of Elliptical Local Ternary Pattern” by Rakcinpha Hatibaruah, Vijay Kumar Nath, and Deepika Hazarika presents a new feature extraction method called sum and difference histograms of elliptic local ternary pattern (SDH-ELTP) for face image retrieval. SDH-ELTP is tested on two popular face image databases and the results are compared with several recent state of the art techniques. The SDH-ELTP is low dimensional and show the best retrieval results as compared to all other face image retrieval techniques.

Happy Reading...